



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



Publication number:

**0 663 719 A3**

## EUROPEAN PATENT APPLICATION

Application number: 94309627.1

Int. Cl.<sup>6</sup>: H03F 3/45

Date of filing: 21.12.94

Priority: 12.01.94 JP 1747/94

Date of publication of application:  
19.07.95 Bulletin 95/29

Designated Contracting States:  
DE FR GB IT

Date of deferred publication of the search report:  
06.09.95 Bulletin 95/36

Applicant: **HITACHI, LTD.**  
6, Kanda Surugadai 4-chome  
Chiyoda-ku,  
Tokyo 101 (JP)

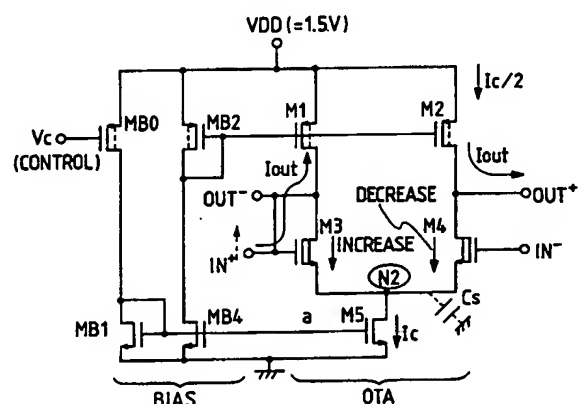
Inventor: **Tamba, Yuko**  
10-10-3-206, Kabe-machi  
Ohme-shi,  
Tokyo (JP)

Representative: **Calderbank, Thomas Roger et al**  
**MEWBURN ELLIS**  
York House  
23 Kingsway  
London WC2B 6HP (GB)

54 Analog filter circuit and semiconductor integrated circuit device using the same.

57 As a Gm-controllable amplifier used in an OTA-C filter, is used an amplifier in which a constant voltage from a bias circuit is applied to the gates of load MOSFETs connected to the drains of input differential MOSFETs of a differential amplifier to allow the load MOSFETs to operate as constant current sources and the inverted output terminals of the circuit are connected to the input terminals. The load MOSFETs of the input differential MOSFETs are made to operate as the constant current sources, so that the drain voltages of the input differential MOSFETs become independent of the threshold voltage of the load MOSFETs. Even if the supply voltage is set to as low as about 1.5 V, the input differential MOSFETs can be prevented from being unsaturated when the input signals rise. Since, moreover, the inverted output terminals are coupled to the input terminals, the currents outputted from the inverted output terminals in the opposite direction of the current coming from the non-inverted output terminals can be absorbed from the non-inverting input terminals, so that the balance of the circuit can be easily held.

FIG. 1





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 94 30 9627

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	IEE PROCEEDINGS G ELECTRONIC CIRCUITS & SYSTEMS., vol.137, no.4, , STEVENAGE GB pages 309 - 314, XP000142754 R. KLINKE ET AL 'CMOS OPERATIONAL AMPLIFIER WITH NEARLY CONSTANT SETTLING TIME'	1-3,6-8	H03F3/45
A	* page 313, paragraph 4 - page 314; figures 9,10 *	4,5,9-11	
Y	DE-U-93 00 550 (AMERICAN TELEPHONE AND TELEGRAPH) * page 1, line 6 - page 3, line 28; figures 1,2 *	1-3,6-8	
A	1993 IEEE INTERNATIONAL SYMPOSIUM ON CIRCUITS AND SYSTEMS, vol.2, 3 May 1993, CHICAGO IL pages 1120 - 1123, XP000379169 B.A. BLOW ET AL 'A DUAL FREQUENCY RANGE INTEGRATED CIRCUIT ACCELEROMETER USING CAPACITIVE AND PIEZOELECTRIC SENSING TECHNIQUES' * page 1121; figure 4 *	4,5	
A	EP-A-0 254 323 (FUJITSU LTD) * column 6, line 19 - column 8, line 4; figure 3 *	12	
A	EP-A-0 355 906 (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) * column 4, line 25 - column 5, line 52; figures 1B,5B *	12-14	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 18 April 1995	Examiner TYBERGHIE, G
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

EPO FORM 1501 (12.92) (P04C01)



European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 94 30 9627

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	IEEE JOURNAL OF SOLID-STATE CIRCUITS, vol.28, no.9, 3, NEW YORK US pages 962 - 970, XP000395448 R.P. MARTINS ET AL 'AN OPTIMUM CMOS SWITCHED-CAPACITOR ANTIALIASING DECIMATING FILTER' * page 966, left column; figure 8 * -----	1-3	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 18 April 1995	Examiner TYBERGHIE, G
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document			



European Patent  
Office

## CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claims:
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

## LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet -B-

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respects of which search fees have been paid, namely claims:
- ☒ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,

1-15

namely claims:



European Patent

Office

EP 94 30 9627 -B-

### LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 1-15: A differential voltage/current convertor with controlled biasing
2. Claims 16-20: An analog filter circuit